Spawning habits, eggs and early development of Deccan Mahseer, *Tor khudree* (Sykes)

BY

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(With five text-figures)

INTRODUCTION

Mahseers, a group of large Indian carps, are well known as excellent game fish in India, comparable to similar sport fish elsewhere in the world. They had attracted the attention of angler naturalists like Thomas (1897) Skene-Dhu (1918) Macdonald (1948) etc., who wrote on the natural history and the special traits of the fish from the anglers' point of view. Hora (1939, 1941, 1942) wrote several articles on the taxonomy, distinguishing characters of the species, races and colour varieties of Mahseers of India and Burma. Hora & Nazir Ahmed (1946) described the spawning habits of Katli Mahseer of Assam and Nazir Ahmed (1948) described the early stages of the Copper Mahseer, *Lissochilus hexagonolepis*. David (1953) dealt with the bionomics and some early stages of the Mahanadi Mahseer, *Barbus* (*Tor*) *mosal mahanadicus*. Recently Karamchandani *et al.* (1967) gave an account of fishery and biology of *Tor tor* (Hamilton) from Narmada River, Madhya Pradesh. Several other notes on Mahseers are also available, nevertheless, very little is known about the breeding habits and early development of the Deccan Mahseer, *Tor khudree* (Sykes). I had recently an opportunity to study the breeding habits and early development of this fish (*T. khudree*) at lake Walwhan of the Tata Hydro-Electric Power Supply Co., near Lonavla, Dist. Poona. The lake has a water spread of about 800 ha. and a maximum depth of 17 m. Despite the usual difficulties of obtaining mature brood fish at the right time, eggs and early stages were obtained by stripping ripe males and females and by fertilising the eggs artificially. A descriptive account of this work is given.

BREEDING SEASON OF *Tor khudree*

It is well known that the breeding season of Indian carps is, but for slight variations, more or less common namely during the early part of the monsoon season. Mahseers, though belonging to the same

family, appear to have, according to published accounts, a varied breeding season. Day (1872), Beavan (1871) & Skene-Dhu (loc. cit.) believed that Mahseers breed several times in a year including monsoon months. Thomas (1897) recorded their breeding at intervals during post-monsoon months. Macdonald (1948) states that 'the Putitor Mahseer is said to spawn three times in the year. In the Punjab, the three spawning seasons are (1) January-February (2) May & June (3) July to September.' Nazir Ahmed (loc. cit.) observed the breeding season of Assam Mahseer to extend from April to October with a peak in August and September; whereas David (loc. cit.) states that the Mahanadi Mahseer breeds after the monsoon between November and January. He adds that 'in *Barbus* (*Tor*) *khudree* and *Barbus* (*Tor*) *mussuallah* spawning takes place in November in the Cauvery system'. Karamchandani (loc. cit.) records that breeding season of *Tor tor* commences in July-August and continues up to December. From the above records, it would be seen that there are different observations largely indicating that the spawning season is not limited to a short period of one or two months like in other major carps but is a prolonged one. However, the observations made at Lonavla (Walwhan Lake) during July and August 1970 indicate that these two months, or more precisely a period of a month or so in these two months represents the spawning period. Records of fish caught from the above lake with the help of gillnets operated in the spawning area are as under:—

Date	No. of fish caught	♂♂	♀♀	Condition of fish
31-VII-70	30	20		Oozing—18 spent—2
			10	Oozing—nil full—9 spent—1
3-VIII-70	9	5		All ripe
			4	3 ripe (loaded) 1 spent
8-VIII-70	17	11		7 ripe 4 spent
			6	2 half spent 4 spent
21-VIII-70	21	17		15 spent 2 half spent
			4	2 spent 2 half spent
27-VIII-70	26	22		12 spent 10 half spent
			4	3 spent 1 half spent

It will be seen from the above catch details that the last few days of July and the first week or ten days of August was the spawning period for the year 1970. Connecting this with the meteorological conditions such as rainfall and the resulting changes in the lake levels, it would be seen that out of the yearly (monsoon season) rainfall of 4285 mm. (160 in.) about 1825 mm. (73 in.) fell up to July 31, 1970, when the spawning activity appears to have set in. At this time the lake level rose from 6·62 m. (21·7 ft.) on 3-vi-70 to 8·5 m. (27·89 ft.) and the temperature of water fell to 24°C. This rise in the level enabled the mature fish to approach some of the streams which flow into the lake. Level areas at the confluence of these streams with the lake were inundated and provided spawning beds, though the actual spawning activity with the usual commotion could not be seen. Rainfall in the lake area commenced from 4-vi-70. The stimulus of rainfall and dilution of lake water can therefore be said to have commenced from that day and to have activated the gonadotropic hormone secretions stage by stage. Actual flooding and low temperature of water triggered the spawning activity. Early part of monsoon of 1970 was rather weak at Lonavla and this might have delayed the normal onset of breeding activity at the lake. Even then from the number of ripe fish caught on 31-vii-70, it can be surmised that the activity had already started. The area where netting was done receives water from three hill streams expected to attract breeding fish. Though the number of fish caught appears to be small, taking into consideration the depth and extent of the main lake, the shallow small area of water fished and the length of the net used, the catch indicates fairly enhanced activity of the Mahseers. On 8-viii-70 large females (3 Kg.) in half spent condition were obtained. It is probable that the half spent condition may be due to their being caught in a gillnet where they usually struggle for their life before they are removed and kept in a conditioning net. During this struggle they may have shed their eggs. Half spent condition after removal from the net is, therefore, considered as ripe and full. However, the catches in the second fortnight of August 1970 indicate that although adult fish were caught, most of them were spent. The spent condition indicated that spawning was over. Whether the same fish has another spell of spawning has to be examined in future. However, from the details gathered so far, a fortnight or two between late July and early August seem to be the peak breeding period of Mahseer in Walwhan and also its adjoining Shirawta Lake.

Two of the females caught on 8-viii-70 which were in ripe condition, though actually half spent, were stripped and the eggs fertilised with the help of milt of the males caught with them. About 10,000 eggs

were thus obtained, the fertilization being about 90%. It was probably for the first time in India that such a large number of eggs of Mahseer were obtained by stripping, fertilised successfully and grown to fry and fingerling stage excepting Nazir Ahmed's (loc. cit.) initial effort with the Copper Mahseer of Assam on a smaller scale. For the Deccan Mahseer, this is the first time that the eggs, post larvae and fry, are obtained and described.

Distinguishing characters of male and female Mahseers

Sexual differentiation of Mahseers is not quite apparent to an untrained eye. Coloration in all fins is uniformly bluish in both sexes and the body pale golden yellow and abdomen white. However, the pectoral fin of the male is comparatively longer, reaching the seventh scale below the lateral line. Its outer ray is pointed, straight and its inner margin also almost straight. The pectoral fin of the female is short, reaching below the fifth or sixth scale of the lateral line and its inner margin is concave. Its fin membrane is thicker than in the male and its outer ray is bent inwards. Apart from the bulkiness of the abdomen giving rise to an arched ventral profile, another distinguishing feature of the female is that the base of the anal fin projects out of the profile line, while the profile is comparatively straight or less arched and the base of the anal fin does not very much project out of the profile line in the male. Fine tubercles are sometimes present on the gill cover below the eyes in the male but this character is not always reliable. Similarly the roughness of the pectorals in the males is only slightly felt and requires considerable experience.

Development of the Deccan Mahseer, *Tor khudree* (Sykes)

Egg & Embryo :

The eggs of *Tor khudree* are distinctive in as much as they are not colourless like those of Catla, Rohu, etc. but are bright lemon yellow verging on golden brown. They resemble eggs of *Puntius kolus* but are larger than the latter. The perivitelline space is small and they absorb only a small quantity of water. The egg is about 2·5 mm. in diameter when freshly laid and increases in size to 3·2 mm. after absorption of water. Unlike egg of other carps, they are comparatively heavy and demersal, and they are also not soft and smooth like other carp eggs but tough and somewhat rough to touch. They resemble

trout eggs but are smaller in size and comparatively lighter in weight. Figure 1a illustrates a freshly laid egg, heavily yolked and without oil globules. Figure 1b indicates an egg three hours after fertilization.

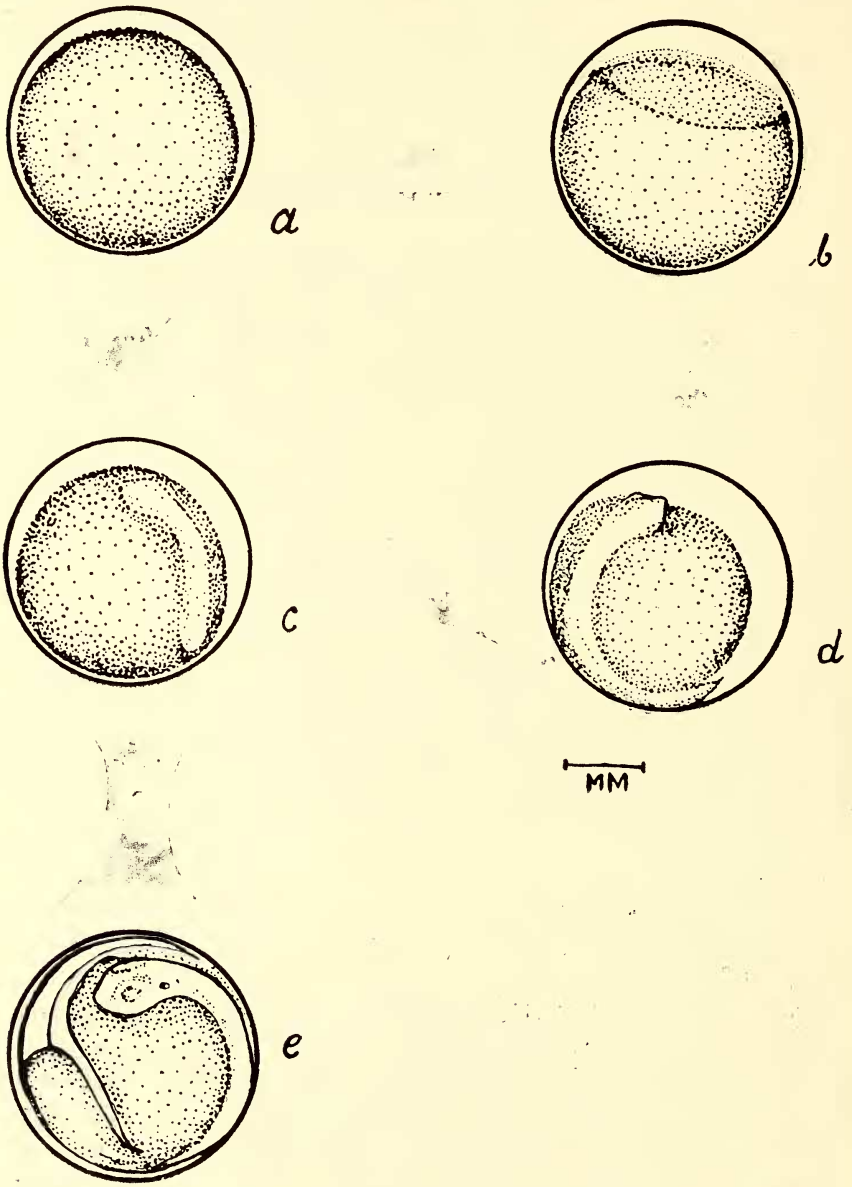

Fig. 1: Eggs of Mahseer, *Tor khudree* (Sykes)

a: Newly laid egg. b: Egg, three hour after fertilization. c: Egg, 24 hours after fertilization. d: Egg, 48 hours after fertilization. e: Egg, 58 hours after fertilization.

It shows a cap of protoplasm gathered at one pole of the egg forming a blastodisc.

After 24 hours (Fig. 1c), the embryo develops further and becomes comma shaped; the cephalic portion can be distinguished but the optic lobes are not clear. The head as well as body of the embryo are closely attached to the yolk. There is no visible movement of the embryo.

After 48 hours (Fig. 1d), the head as well as the tail portion of the embryo are prolonged and they are distinctly seen raised on the surface of the yolk which is now comparatively reduced in size. Twitching movements of the embryo are seen but they are slow and occur after an interval of two or three minutes. The movements at this stage are not jerky as in the Rohu or Catla eggs. Outline of the eyes and the lens are seen but no pigment in the eyes is yet visible.

After about 58 hours, there is not much apparent change in the embryo but the body becomes more defined and clearer, and the head well-defined. The sclerotic ring and the lens are seen but without pigment. Movement of the embryo within the egg has now become more frequent and vigorous than in the previous stage. This movement is so forceful that it makes the egg roll if kept in a flat petrie dish.

After 60 hours the eggs hatch and at the time of hatching, the actual rupture of the egg membrane takes place by the lashing movements of the tail, which bends below the abdomen and then straightens out. Out of the three eggs watched in this way, two hatchlings came out normally and without difficulty but the third had its large yolk sac and head entangled in the egg membrane. This is due to the relatively large yolk sac which may prove to be a handicap leading to a sizeable mortality in natural hatching.

The second batch of 14 eggs observed hatched out between 60 and 72 hours and the third batch of 16 eggs between 72 and 80 hours. It can be thus assumed that under laboratory conditions where water is aerated and changed occasionally and the ambient temperature is largely constant at 29°C, and water temperature 27°C, the hatching period is 60 to 80 hours. In nature, if the conditions are more favourable, the period may be shorter, but in all probability this may not be the case, with the variations in day and night temperatures, depending on whether the eggs are deposited in shallow or deep waters and whether they are lumped together or spread out.

Hatchling :

The first post-larva or the earliest hatchling of the Mahseer (Fig. 2) is about 9 mm. in total length and has a large, prominent, yellow,

yolk sac divided into two lobes. Its anterior part is larger (*c.* 2.8 mm. in length) and more rounded than the posterior (*c.* 2·5 mm. in length) which is elongated. The eyes are formed, the eyeball and the outer

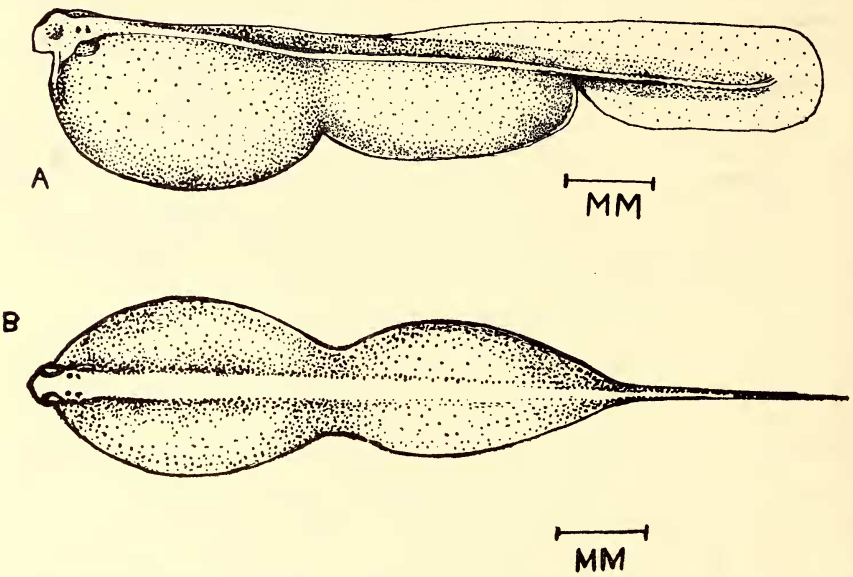

Fig. 2. a: Lateral view of a newly hatched post-larva (hatchling) of *T. khudree* (Sykes). b: Dorsal view of the same.

ring can be seen but there is no pigment. The otocysts can be seen in live specimens. The heart pulsates at about 100 to 105 beats per minute. A few colourless blood corpuscles could be seen. The aorta is also formed. Except for the colour of the yolk sac, the post-larva is colourless. A continuous embryonic fin fold starts dorsally from the middle of the two lobes of the yolk sac and proceeding backwards round the caudal portion, ends ventrally near the posterior margin of the yolk sac. Pectoral is seen as a minute bud. No traces of fin rays are seen at this stage in any fin area.

The post-larva remained quiescent on its side at the bottom of the tray and moved in jerky manner, vibrating its tail only when slightly disturbed.

Three day old post-larva :

Total length 11 mm. Rests on its yolk sac ventrally and with the dorsal finfold pointing upwards (Fig. 3). Towards the end of the third day, it moved more frequently than before but remained at the bottom, though a few occasionally swam momentarily upwards in the usual jerky manner and again settled on the bottom.

A significant development at this stage is the appearance of pigment in the eyeball and melanophores on the dorsal side of the eye. On

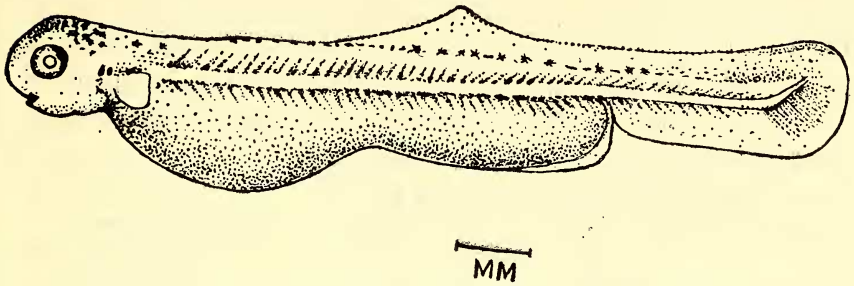

Fig. 3. Three-day-old hatchling of *T. khudree* (Sykes).

both sides of the dorsal fin fold there are black chromatophores. The pectoral fin now develops. Gill covers are well defined and gill filaments are seen. The jaws are formed. In living specimens, the black eyeball has a golden ring surrounded by black chromatophores. Otocysts are clearly marked. The pulsating heart can be clearly seen and the blood corpuscles have become distinctly red in colour. The two portions of the yolk sac appear to be losing their distinctness by reduction of the constriction between them and merge into a long but anteriorly enlarged yolk sac. The dorsal finfold is extended or produced upwards at the place of origin of the dorsal fin. Fin rays on the lower lobe of the caudal fin make their appearance. The anal opening develops.

Six day old post-larva :

Total length of fry 12 mm. (Fig. 4). Though there is not much increase in total length, the structural development has gone fairly

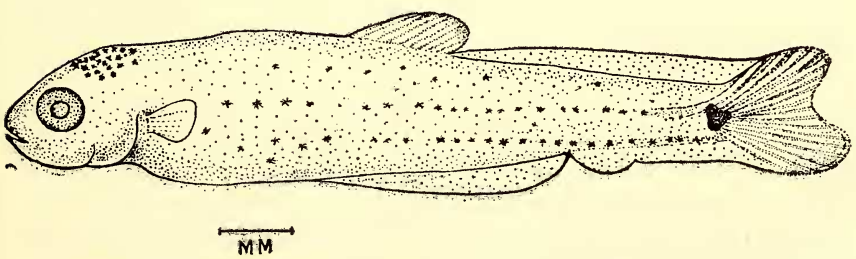

Fig. 4. Six-day-old hatchling of *T. khudree* (Sykes).

apace. In addition to the pectorals, the dorsal fin is clearly demarcated from the original fin fold and as many as ten rays in the formative stage are visible. The caudal fin lobes are marked out and

full 19 fin rays could be counted. The anal fin lobe is discernible but without fin rays. Anal opening and a part of the anal track is visible. A fin fold has developed on the posterior portion of the yolk sac but anterior to the anal opening. The constriction between the anterior and posterior portions of the yolk sac had completely disappeared and the latter becomes a continuous fusiform structure.

The eyes have become prominent and bright. Chromatophores have appeared on the head and slightly behind the eyes. A double row of small pigment spots is seen on either side of the dorsal fin, between the lateral line and dorsal profile line. Small chromatophores occur on the body also. A distinct congregation of chromatophores forming a black spot or a blotch is seen on the base of the caudal fin. Anterior to and above the yolk sac and below the vertebral column, an air bladder develops which when viewed from above, appears oval. This is seen only in living specimens. The jaws are constantly in motion.

The fry at this stage (12 mm.) is erect but not free swimming and prefers to remain at the bottom when not disturbed. In a net, they prefer to remain huddled together. This habit may lead to heavy mortality either due to lack of oxygen in the corners where they congregate or to a prowling predator getting a large number of motionless fry settled in one place at a time.

On the 8th day, the fry commenced swimming but they preferred to move on the side walls of the net, probably simulating the adult habit of browsing on submerged rocks. The behaviour could also be interpreted as disinclination or inability to swim freely in the open waters. The sedantary habit accompanied by occassional jerky movements for about 8 days may make the fry an easy prey to predators who may be attracted by the movements and the comparatively large size of the fry.

Eleven day old fry :

At eleven days, the fry becomes a free swimming individual and feeds on Moina, small Daphnia and Cyclops. It has not progressed much as far as its length is concerned, it being only 13.5 mm. in total length. In addition to the concentration of chromatophores on the head, a row of elongated or dash-like chromatophores are seen along the lateral line and also on the caudal rays and the ventral line between the anal opening and the caudal fin. The caudal blotch is distinct and somewhat triradiate when viewed under a microscope. The yolk sac is not yet fully absorbed. The air bladder continues to grow in size. About 38 vertebrae could be counted in a living specimen.

Further progress in fin formation is seen in the appearance of a small bud representing the pelvic fin, a small finfold yet continuing on its anterior and posterior side. A finfold at the base of the caudal is also persistent. The caudal is now distinctly forked and anal fin has developed seven rays. Dorsal has ten fin rays and is situated almost midway between the base of the caudal and the top of the snout, but slightly in advance of the pelvic fin bud. The dorsal profile is rounded; the ventral being almost straight except at the yolk sac portion.

Twenty day old fry :

The 20-day old fry (Fig, 5). is an actively moving individual about 26 mm. in total length. It continues to feed on Moina, Daphnia, etc. The body is covered with small chromatophores but as they are sparse

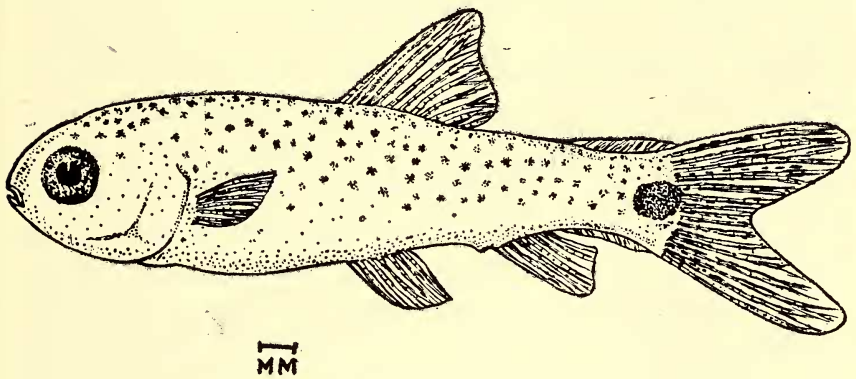

Fig. 5. 20 days old fry of *T. khudree* (Sykes).

and small, the general colour of the fry appears yellowish. No chromatophores are seen on the abdomen and below the head, the area appearing clear white. Small elongated chromatophores are formed on the caudal and dorsal fin rays but in the case of the anal, they are situated on the basal portion of the first two branched rays only. They are absent on the pelvic and pectoral fins. The caudal blotch is quite prominent and its triradiate form has changed into somewhat oblong form with broken margin.

The yolk sac has disappeared and the ventral profile is almost straight The dorsal profile continues to be arched. It becomes more prominently arched on fixation in formalin. Along with other fins, the pelvics are also well developed. The anal has 8 fin rays. They are simple but branched only at the terminal portion. Dorsal has eleven rays. The first undivided ray is just developing, the second and third undivided rays are clearly seen. Other rays are branched

only at their terminal portion. In the pelvics also, the first ray is rudimentary the second undivided and the rest branched terminally.

The fry is thus well developed in all respects. In an unhealthy or ill fed fry, the chromatophores are more dense and consequently the fry looks blackish in colour and not yellowish as in the case of healthy ones. Similarly the rate of development may also change in unfavourable conditions.

Pisciculturai possibilities

The present observations indicate that if ripe males and females could be obtained at the right time, stripping and artificial fertilization are not difficult. The eggs being tough and hard and the hatching period being long, (60 to 80 hours), transportation of eggs over long distances is feasible in properly designed trays or boxes as in the case of trout eggs. Compared to Catla, Rohu etc. there is less mortality in the eggs after fertilization. Similarly the hatchlings and fry seem to be hardy. Although the critical quiescent period is very long, nearly 7 to 8 days after hatching, mortality is fairly low if proper care is taken and hatchlings are not allowed to lie or rest on muddy surfaces. Further, as the quantity of yolk is fairly large, the hatchlings at the time they become free swimming, are large enough to take Moina, small Daphnia, etc. The hatchlings being more than 12 mm., when they become free swimming, there is hardly any spawn stage. They can be said to emerge as fry only. After four days, they take finely macerated hard boiled egg albumen. Thus raising of fry is not difficult, but the long hatching and quiescent period is not conducive to large output unless a lot of space and other facilities are available.

Apart from the unquestionable utility of Mahseer for lakes in which angling is practised, the fish being good eating, it can be grown in ponds and may add to the list of culturable species in tropical and especially sub-tropical waters where other species of Mahseer are known to thrive. It is reported that large numbers of Mahseer fry can be collected from rivers and streams of Himachal Pradesh. From Narmada also fry are collected in Madhya Pradesh. David (loc. cit.) reports occurrence of large number of fry in Mahanadi and records a growth of 170 to 200 mm., in natural ponds in four months. However, further observations on the food of juveniles and their rate of growth are necessary.

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